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Implementation of Lean Six Sigma to Reduce Work Time Waste in the Goods Transportation Department

Uni Pratama Pebrina Tarigan[a], Rhevenson Novemingsen[b], David Lu[c]
[a,b,c] Department of Industrial Engineering, Universitas Prima Indonesia
Corresponding Autor: unipratama@gmail.com

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A B S T R A C T

Lean Manufacturing is a manufacturing concept to seek to suppress waste or also known as waste. There are seven wastes in Lean need to be eliminated, which include: excessive production, inefficient material transportation, waiting time, the value that has no added value, inventory, movement, and defective products. Value stream mapping will be used in this study to identify waste and explore activities that have the potential to become wasteful. Opportunities for existing waste will be reduced so as not to result in waste. Research is expected to produce processes that are more efficient so as to reduce activities that do not have added value. That way, this research can be useful in overcoming company problems where delays often occur in the delivery process.

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1. Introduction

Transportation is the movement of goods or people from one place to another by using Machine Power or Living Creatures. Transportation is one of the problems in trade because time wastage can cause costs to increase too. Many companies find it difficult to arrange regular deliveries without compromising customer satisfaction. If left unchecked, it will eliminate consumer trust, where consumer trust is all information obtained based on the conclusions it gets (Mowen, 2011), just like what happened recently with SiCepat. SiCepat delivery delays make consumers even more reluctant to use their delivery services.

PT Ocean Furnindo is a company engaged in the manufacturing industry that produces bedding. Shipments owned by PT Ocean Centra Furnindo cover all of Indonesia and even the international world. Of course, this has become a big problem seeing that the existing market is quite widespread and this problem must be addressed immediately so that it does not continue to be sustainable so as not cause more fatal problems in the future. Delivery delays often occur due to PT Ocean Centra Furnindo's lack of planning in arranging shipments which result in a waste of time.

Based on existing data. Delivery delays continue to increase every year. Wasted time can also result in wasted costs in the future. As a result of this lack of planning, order cancellations often occur which result in stocks piling up and are still continuing today. To prevent future wastage of costs, we aim to dispose of activities that result in wastage of existing activities at PT Ocean Centra Furnindo.

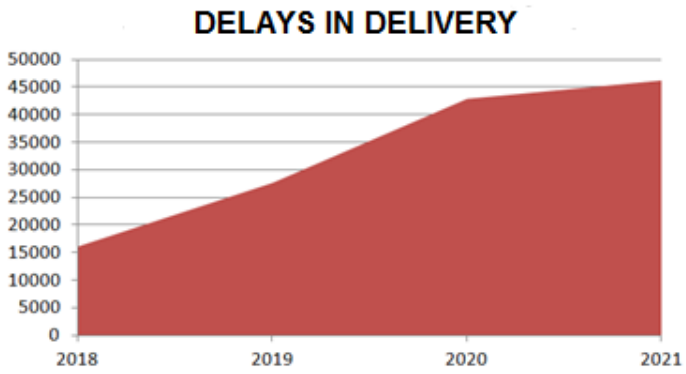

Figure 1. Delivery Delay Data
Source: PO cancellation report and Sales

The Lean method is the most suitable method for this company's problems, with the hope of minimizing waste and reducing waste of time which can impact costs. This study aims to reduce the wastage of time by maintaining values that affect and reducing values that do not affect the process and is expected to solve the problem of delays by rearranging existing activities

For research to focus on problems and objectives, it is necessary to provide problem boundaries. The limitations of the problem that will be used in this study are shipments that occur only for shipments to Riau, and what is studied is only shipments from the PT Ocean Centra Furnindo office where the activities are repetitive, and the workers are in good physical condition.

2. Literature Review

Lean is a structured way that is used to eliminate activities that do not have added value or are also called Non-Value Added by eliminating the causes of existing waste or waste to increase value to customers. Lean becomes a philosophy of business based on minimizing the use of existing resources for various company activities, through optimization efforts with successive improvements, so that it can focus on identifying and eliminating activities in the fields of services, design, manufacturing, as well as supply chain management (SCM) which deals directly with customers is the definition given by The Association for Operation Management (2013).

The definition of Lean Manufacturing is a method used to maximize results/output by minimizing waste, the benefits themselves of course reduce product lead times and production costs. There are four objectives of Lean Manufacturing is to minimize wastage to improve product quality reduce costs and Minimize the use of time. Waste is spending costs or time that is not efficient and effective, resulting in wastage. The waste that occurs does not have added value or influence on activity. The Toyota Production System is the inspiration for Lean and is now a symbol of the progress of the automotive industry in Japan. Seven wastes must be eliminated in lean manufacturing:

a. The production process is over capacity
   This waste occurs due to excess production of finished and semi-finished goods. The reason can be low quality and long setup times.
b. Waste on Inventory
   This waste occurs because raw materials take up a lot of space, so it requires very large capital to increase inventory capacity.
c. Defects in the product
   This waste occurs because the goods produced do not meet standards, so the quality is very bad and needs improvement. These product defects result in additional costs, such as workers' wages and components that will be used for repairs.

d. Waste on transportation
   This waste occurs as a result of activities that do not have added value, resulting in additional costs and can even result in loss of trust from customers due to goods arriving in excess of estimates.
e. Waste of movement
   This waste occurs as a result of the movement of workers who are not needed, so it becomes a waste of time.
f. Waste that results in waiting too long
   This waste occurs as a result of delays so that work becomes delayed resulting in workers waiting for a long time. This waste results in an unbalanced process.
g. Waste that results in redundant processes
   Excessive processing is not suitable for the procedure. This absurd process is caused by inefficient, wasteful processes such as repeated and approval processes involving many people.

3. Methodology

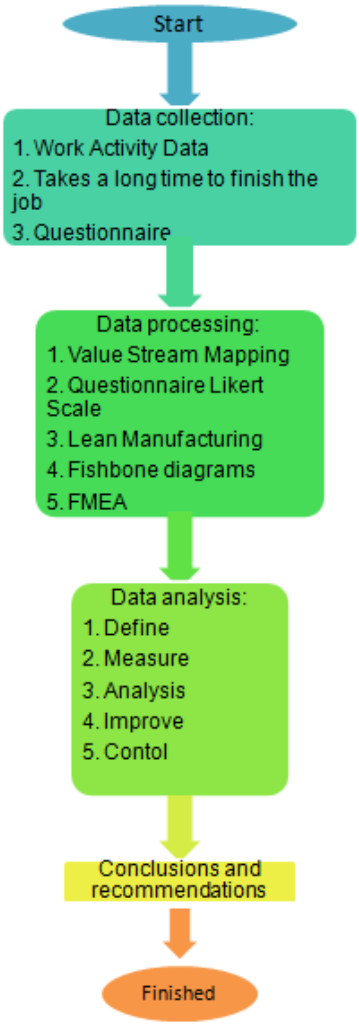

Figure 2. Research flow chart

4. Results and Discussion

The data is summarized in the Flow Process Chart (FPC) to determine the type of activity. The following is a summary of what we have proposed:

Table 1. Activity Flow Process Chart (FPC)

Flow Process Chart		
Activity	**Amount**	**Duration (Minutes)**
○	3	190
▭	2	240
⇨	8	1340
D	6	1740
▽	-	-
Total	19	3510

No	**Description about**	**Symbol**	**Duration (Minutes)**
1	Item confirmation		180
2	Payment		10
3	Payment check		120
4	Delivery of Goods from factory to warehouse		60
5	Goods transported to the warehouse		80
6	Shipping delays		210
7	Meal break before delivery		60
8	Preparation		60
9	Truck check		120
10	Transporting		360
11	Driver take a rest		480
12	Preparing for transport		120
13	Transporting		240
14	Driver take a break		60
15	Changing driver		10
16	Goods on the way		420
17	Truck park at parkzone (driver take a rest)		740
18	Goods sent to destination		60
19	Transfer of goods to the destination warehouse		120

The activity data contained in the Flow Process Chart is entered into the VSM tool. Through VSM we find out which activities have added value and which do not. Here are the pictures we provide:

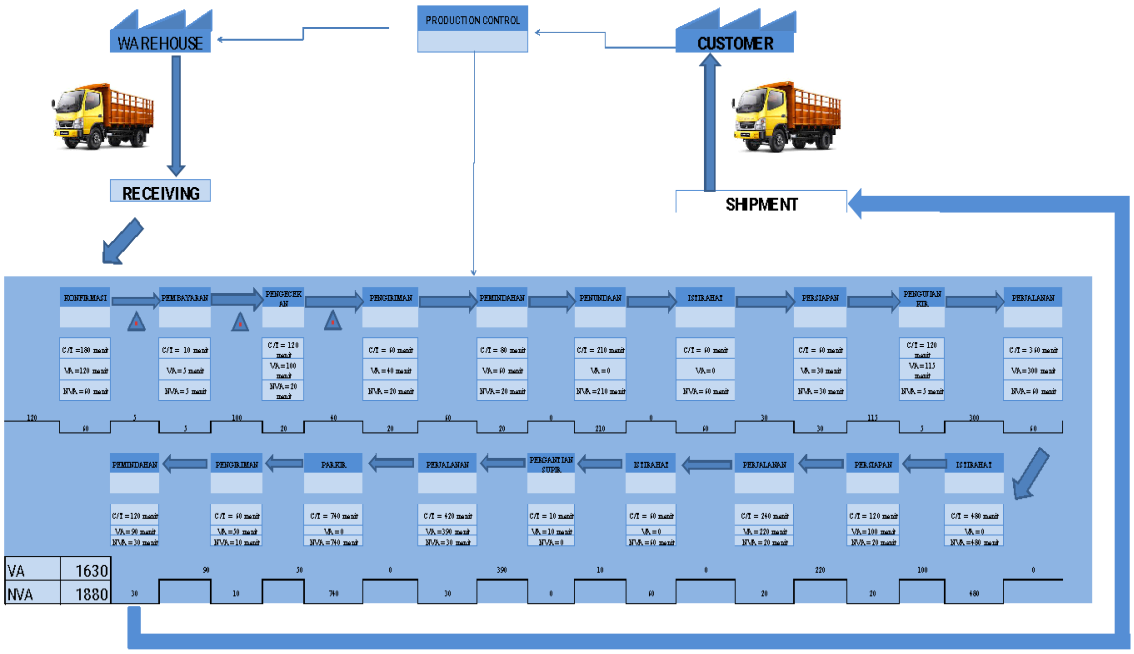

Figure 3. Value Stream Mapping process

Calculation to find out the percentage of question scores

Table 2. Questionnaire percentage recapitulation

Recapitulate	Total Score	Average	Percentage
Workers must wait for orders in advance to do something	70.66	8.83	16.51
Workers often spend time on unnecessary things	70.66	8.83	16.51
There are often delays in delivery	82.66	10.33	19.31
There is socialization with several departments before delivery	34.66	4.33	8.10
Everything has been scheduled regularly	52.00	6.50	12.15
There is often excess stock	38.66	4.83	9.03
Stock checks are carried out regularly once a week	37.33	4.67	8.72
Goods and activities have complied with the SOP	41.33	5.17	9.66

Based on the above data, a diagram is made as follows:

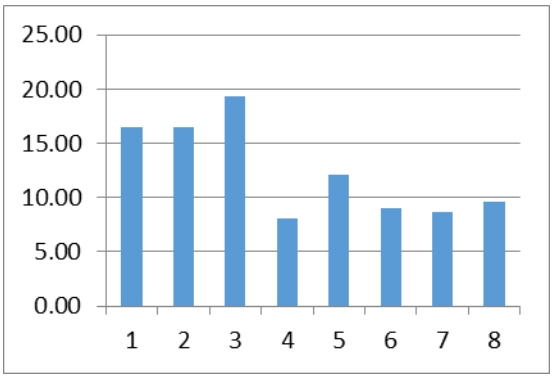

Figure 4. Failure Mode Diagram

Based on the diagram that has been obtained, it is known that number 3 gets the highest score whereas number 3 concludes that respondents agree that delays often occur in delivery. In addition to the failure modes that we have obtained, VA/NVA and NNVA tables are also made. The Value Added table is an activity that affects the process of running the transportation, so this value will be maintained later.

Table 3. Value Levels

No	Activity	Value Tiers		
		VA	NVA	NNVA
1	Item confirmation	√		
2	Payment	√		
3	Payment check			√
4	Delivery of goods from factory to warehouse	√		
5	Goods transported to the warehouse	√		
6	Shipping delays		√	
7	Meal break before delivery		√	
8	Preparation		√	
9	Truck check			√
10	Journey	√		
11	Rest driver		√	
12	The driver is preparing		√	
13	Journey	√		
14	Break driver		√	
15	Change of driver		√	
16	Goods on the way	√		
17	The cars are parked at the truck parking			√
18	Goods sent to destination	√		
19	Transfer of goods to the destination warehouse	√		

An analysis is needed to find out the causes of waste problems or failures that exist in existing activities. This analysis uses the Fishbone Diagram method. This stage is obtained from the measuring stage based on the recapitulation of the Questionnaire Results.

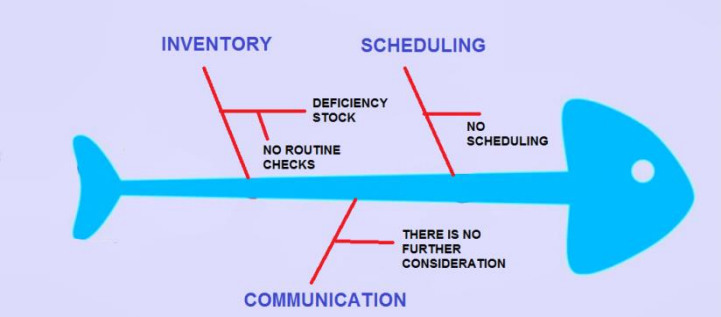

Figure 5. Fishbone Diagram for Waste I

The waste above is the waste of waiting, where the delay comes from bad communication resulting in miscommunication that occurs from the absence of prior consideration, and the absence of good scheduling resulting in delays in the goods to be sent. Another contributing factor is inventory problems, where there is a shortage of stock due to the absence of routine checks. This certainly affects the communication that will also occur in the future which results in order cancellation

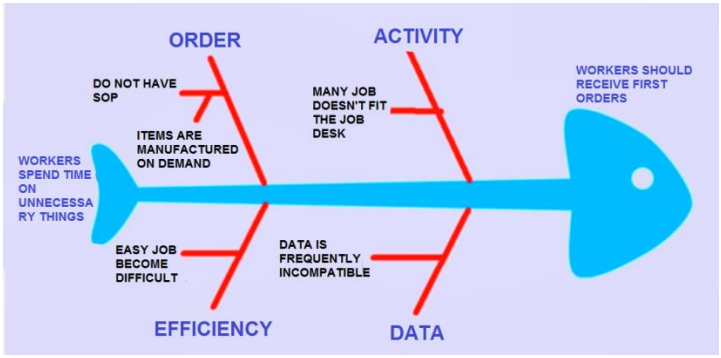

Figure 6. Fishbone Diagram for Waste II

The waste above is a waste error, goods that are produced only based on the wishes of the customer so that the data provided is not appropriate and makes workers not understand each other's job desk which results in work that should be easy becoming difficult.

After the root causes that cause waste is found, the next step is to measure the risks that will result from the causes of waste in transportation activities. So that we know this, this study uses Failure Modes and Effects Analysis (FMEA) as the method used to measure the causes of waste with the highest risk.

Table 4. Table of Failure Modes and Effects Analysis (FMEA)

NO	FAILURE MODE	Severity (S)	Occurance (O)	Detection (D)	RPN	RANK
1	There are no routine stock checks	6	7	8	336	2
2	No scheduling	7	9	5	315	3
3	There is no consideration beforehand	5	5	5	125	5
4	Goods are produced only on request	3	8	3	72	6
5	Easy Jobs become hard	2	3	4	24	7
6	The data provided is sometimes not appropriate	8	5	9	360	1
7	Many do not understand other people's Jobdesk	6	5	7	210	4

Based on the failure modes above, it is known that the highest failure mode rating comes from the data provided is not appropriate, followed by no routine stock checks and no scheduling. Improve is the stage of designing improvements and providing the best solutions, the goal is to eliminate Non-Value Add activities in the processes that occur. After this, a working fix will be made to solve the existing time-wasting problem, here is the design for the improvement that we provide:

a. Improvement Design for Process Cycle Efficiency (PCE)

Table 5. Process Cycle Efficiency (PCE) improvement

No	Activity	Time	The waste that occurs	Action
1	Item confirmation	180	-	Defended
2	Payment	10	-	Defended
3	Payment check	120	-	Defended
4	Delivery of goods from the factory to the cemara warehouse	60	-	Defended
5	Goods transported to the warehouse	80	-	Defended
6	Shipping delays	210	Delay	Omitted
7	Meal break before delivery	60	Delay	Omitted
8	Preparation	60	Delay	Omitted
9	Truck check	120	-	Defended
10	Journey	360	-	Defended
11	Rest driver	480	Delay	Omitted
12	The driver is preparing	120	-	Defended
13	Journey	240	-	Defended
14	Break driver	60	Delay	Omitted

15	Change of driver	10	Delay	Omitted
16	Goods on the way	420	-	Defended
17	The car parks to the truck parking	740	-	Defended
18	Goods sent to destination	60	-	Defended
19	Transfer of goods to the destination warehouse	120	-	Defended

Based on the improved design that has been obtained, 13 activities are maintained and the remaining 9 activities are reduced by removing 880 minutes of wasted time and getting a total time of 2630 minutes or 43.83 hours.

b. Improvement plan for Data Collection.

This design is intended to overcome existing data collection problems. The following are the current improvement plans. Added recording in every production. To facilitate the recording of each production activity, data collection is carried out to classify goods so that goods ordered that are not according to standards can be separated. Periodic checks. In order to find out the remaining stock, periodic checks are carried out to find out the remaining stock so that no order cancellations occur at a later time due to delays as a result of data collection discrepancies. Add training. To facilitate data collection, training was conducted which aims to make workers know each other's job desk so that they are no longer confused and do not wait to be ordered.

c. Improvement plan for the Transportation section.

This design aims to make it easier for workers to avoid delivery delays. The following plans are given. Adding Shifts. Adding truck stop points so that shift changes are made at that point to reduce the estimated time for goods to arrive at their destination. Here's a suggested fix:

Table 6. Activity Improvement

No	Activity	Time (Minutes)
1	Item confirmation	180
2	Payment	10
3	Payment check	120
4	Delivery of goods from the factory to the cemara warehouse	60
5	Goods transported to the warehouse	80
6	Truck check	120
7	Journey	360
8	Shift change	10
9	Journey	240
10	Exchange positions with the driver next	5
11	Goods on the way	420
12	Truck trip to the parking	740
13	Goods sent	60
14	Goods moved	120

The total time obtained is 2525 minutes or 42.08 hours. A total of 985 minutes (16.4 hours) of waste was eliminated. Value Stream Mapping after waste reduction is described as follows:

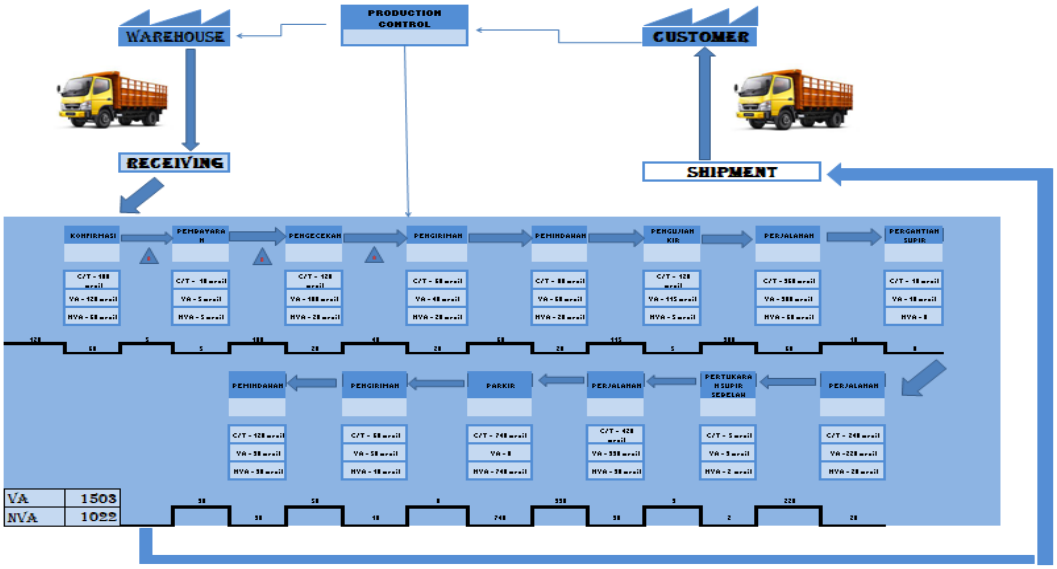

Figure 7. Improved Value Stream Mapping after reducing Waste

5. Conclusion

From the results that have been seen, it can be concluded that the Lean Six Sigma method is very suitable for problems at this PT. In this study, 13 activities were maintained, and reduced 9 activities that did not have added value were by removing 880 minutes of wasted time to get a total time of 2630 minutes or 43.83 hours. (can be seen in Table 4: Process Cycle Efficiency [PCE] improvement plan). The reduced activities were rearranged and eliminated as much as 985 minutes (16.4 hours) of waste which meant that all obstacles to product delivery were removed.

References

Abdulai, M. N., Prah, J. K., Walker, E., & Afrifa, A. D. (2020). A fishbone analysis of the use of electronic health records (EHR) in a primary healthcare setting: the case of university of cape coast hospital. International Journal of Applied Information Systems (IJAIS), 12(33), 27-31.

Adeodu, A., Kanakana-Katumba, M. G., & Rendani, M. (2021). Implementation of Lean Six Sigma for production process optimization in a paper production company. Journal of Industrial Engineering and Management, 14(3), 661-680.

Ahmed, S. (2019). Integrating DMAIC approach of Lean Six Sigma and theory of constraints toward quality improvement in healthcare. Reviews on environmental health, 34(4), 427-434.

Cahyono, A., & Nurcahyanie, Y. D. (2023). Identification and Evaluation of Logistics Operational Risk Using the Fmea Method at PT. XZY. Aptisi Transactions on Technopreneurship (ATT), 5(1Sp), 1-10.

Fauzi, A., Mas'ud, M. I. (2019). Proses Manufaktur pada Mesin Primer dan Sekunder CV. Karunia Menggunakan Metode Linier Programming. Journal Knowledge Industrial Engineering(JKIE), 6(2), 59–65.https://doi.org/10.35891/jkie.v6i2.2055

Godina, R., Silva, B. G. R., & Espadinha-Cruz, P. (2021). A DMAIC integrated fuzzy FMEA model: a case study in the Automotive Industry. Applied sciences, 11(8), 3726.

Hanik, U., & Mas'ud, M. I. (2019). Perencanaan Inovasi Pengembangan Agrowisata Bukit Flora Dengan Pendekatan Metode Bisnis Model Kanvas. JKIE (Journal Knowledge Industrial Engineering), 6(3), 81–90.

Jamil, N., Gholami, H., Mat Saman, M. Z., Streimikiene, D., Sharif, S., & Zakuan, N. (2020). DMAIC-based approach to sustainable value stream mapping: towards a sustainable manufacturing system. Economic research-Ekonomska istraživanja, 33(1), 331-360.

Junaedi, D., Mas'ud, M. I. (2018). Penerapan Metode Forecasting dalam Perencanaan Produksi Bakpia dengan Menggunakan Software POM Guna Memenuhi Permintaan Konsumen. Journal Knowledge Industrial Engineering (JKIE), 5(3), 121–128. https://doi.org/10.35891/jkie.v5i3.2042

Kurniawan, A. (2019). Analisis brand ambassador, brand maskot, dan media iklan terhadap minat pembelian konsumen (Doctoral dissertation, UAJY).

Letchumanan, L. T., Gholami, H., Yusof, N. M., Ngadiman, N. H. A. B., Salameh, A. A., Štreimikienė, D., & Cavallaro, F. (2022). Analyzing the factors enabling green lean six sigma implementation in the industry 4.0 Era. Sustainability, 14(6), 3450.

Li, H., Díaz, H., & Soares, C. G. (2021). A failure analysis of floating offshore wind turbines using AHP-FMEA methodology. Ocean Engineering, 234, 109261.

Mas'ud, M. I., & Wahid, A. (2022). Model SMEs digital disruption management with business model canvas and integer programming. International Journal of Trends in..., 5(2), 162-168.http://ijtmer.saintispub.com/ijtmer/article/view/134%0Ahttps://ijtmer.saintispub.com/ijtmer/article/download/134/102

Mas'ud, M. I., Wahid, A., Nuriyanto, Wibowo, M. M. A., & Pusakaningwati, A. (2022). Effectivity Green Productivity Basis Triple Helix in Tofu Central Industry. Seybold Report, 17(8), 1024–1036. https://doi.org/10.5281/zenodo.7006265

McHugh, A., & Farrell, F. (2023, February). Sustaining the Effectiveness of Lean Six Sigma Implementation in a Medical Device Company. In Lean, Green and Sustainability: 8th IFIP WG 5.7 European Lean Educator Conference, ELEC 2022, Galway, Ireland, November 22–24, 2022, Proceedings (pp. 165-183). Cham: Springer International Publishing.

Nandakumar, N., Saleeshya, P. G., & Harikumar, P. (2020). Bottleneck identification and process improvement by lean six sigma DMAIC methodology. Materials Today: Proceedings, 24, 1217-1224.

Ponsiglione, A. M., Carlo, R., Giovanni, I., Orabona, G. D. A., Alfonso, S., Francesco, A., & Romano, M. (2021). A Six Sigma DMAIC methodology as a support tool for Health Technology Assessment of two antibiotics. Mathematical Biosciences and Engineering, 18(4), 3469-3490.

Rais, A. (2019). Analisis proses operasional shipping dalam pendistribusian part toyota dengan menggunakan metode lean six sigma pada pt serasi logistik indonesia sub depo bandung (Doctoral dissertation, Program Studi Teknik Industri S1 Fakultas Teknik Universitas Widyatama).

Ramani, P. V., & KSD, L. K. L. (2021). Application of lean in construction using value stream mapping. Engineering, Construction and Architectural Management, 28(1), 216-228.

Ridlo, I. A. (2017). Panduan pembuatan flowchart. Fakultas Kesehatan Masyarakat, 11(1), 1-27.

Rodriguez Delgadillo, R., Medini, K., & Wuest, T. (2022). A DMAIC framework to improve quality and sustainability in additive manufacturing—A case study. Sustainability, 14(1), 581.

Siddiqui, A. (2021). Comparing the Workplace Organization Method 5s with the 7 Wastes (Muda) in Waste and Failure Management Tool, in the Health Care Quality Management. Biomed J Sci & Tech Res, 40(1), 31825-31831.

Şişman, G. (2022). Implementing lean six sigma methodology to reduce the logistics cost: a case study in Turkey. International Journal of Lean Six Sigma, (ahead-of-print).

Sommer, A. C., & Blumenthal, E. Z. (2019). Implementation of Lean and Six Sigma principles in ophthalmology for improving quality of care and patient flow. Survey of ophthalmology, 64(5), 720-728.

Suasapha, A. H. (2020). Skala Likert Untuk Penelitian Pariwisata; Beberapa Catatan Untuk Menyusunnya Dengan Baik. Jurnal Kepariwisataan, 19(1), 29-40.

Swarnakar, V., Tiwari, A. K., & Singh, A. R. (2020). Evaluating critical failure factors for implementing sustainable lean six sigma framework in manufacturing organization: A case experience. International Journal of Lean Six Sigma, 11(6), 1069-1104.

Tampubolon, S., & Purba, H. H. (2021). Lean six sigma implementation, a systematic literature review. International Journal of Production Management and Engineering, 9(2), 125-139.

Trimarjoko, A., Hardi Purba, H., & Nindiani, A. (2020). Consistency of DMAIC phases implementation on Six Sigma method in manufacturingand service industry: a literature review. Management and Production Engineering Review.

Vaishnavi, V., & Suresh, M. (2020). Modelling of readiness factors for the implementation of Lean Six Sigma in healthcare organizations. International Journal of Lean Six Sigma.

Zala, S. H. (2022). Implementing lean six sigma methodology for automobile and allied industries to enhance quality and cost effectiveness (Doctoral dissertation, gujarat technological university ahmedabad).